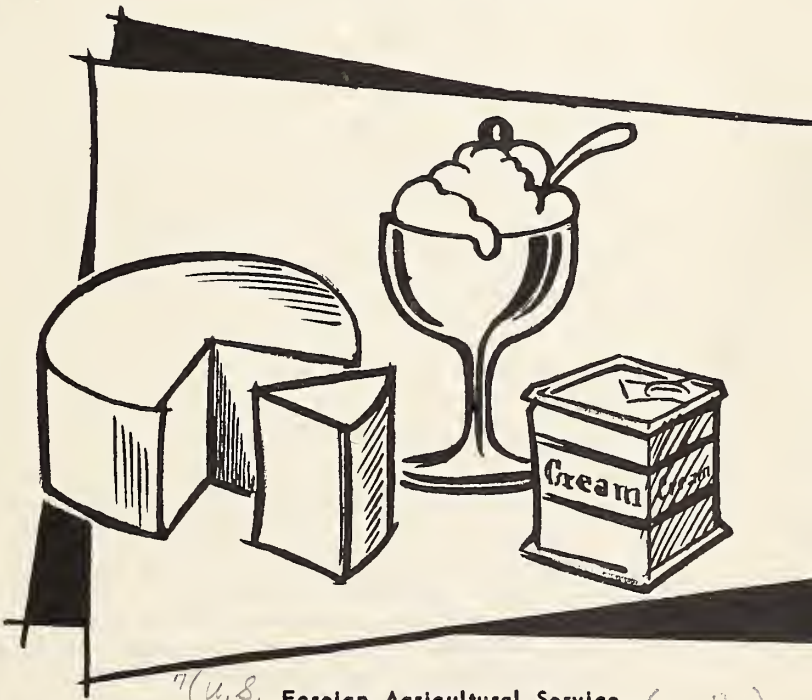
How to use

Recombined Milk Ingredients

In Manufacturing Dairy Products



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Foreign Agriculture Report No. 84, Recombined Milk, published in 1955, gave technical information on setting up plants for the production of recombined fluid milk from low-heat, spray-process nonfat dry milk and anhydrous milk fat in countries where the milk supply is inadequate to meet consumer demand. This report, prepared to supplement Recombined Milk, shows how the same ingredients can be used to produce a wide variety of nutritious, high-quality dairy products for consumers in these countries.

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HOW TO USE RECOMBINED MILK INGREDIENTS IN MANUFACTURING DAIRY PRODUCTS

By

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INTRODUCTION

Countries that import the basic ingredients of recombined milk--nonfat dry milk and anhydrous milk fat--can also use them to manufacture many other dairy items. This report explains how consumers in foreign countries where fluid milk is in short supply can enjoy nutritious manufactured dairy products of high quality.

In the manufacture of many dairy products, it is necessary to use a "starter." This is a bacterial culture of desirable microorganisms in a nutrient material, usually milk. The bacterial action producing fermented milk drinks is known to many peoples the world over. Starters may differ in character according to the type of product to be manufactured. They produce in the finished product the desired characteristic flavor and aroma.

Starters are initially prepared from pure cultures of the types of bacteria necessary to produce the desirable results. (Such pure cultures may be obtained from commercial laboratories.) These bacteria are placed in a small quantity of pasteurized or sterilized milk and incubated so that they will grow and multiply. Their growth develops a "mother culture," or starter. This starter is added to a larger quantity of milk, and when it has developed the desired flavor and aroma we have the "bulk starter" used in the manufacture of the final product. The mother culture or starter is maintained by transferring a portion daily to freshly prepared sterilized or pasteurized milk. A new commercial culture is used if the starter develops undesirable characteristics. Starter preparation will be described in more detail for each dairy product requiring its use.

CULTURED (LACTIC) BUTTERMILK

STARTER PREPARATION

Reconstitute nonfat dry milk to 11 percent solids (amount of nonfat dry milk is 11 percent of the total weight of the nonfat and water) with a good-quality water. Fill a quart or liter bottle two-thirds full, heat, and hold at 190°-200°F. (87.8°-93.3°C.) for at least an hour. Cool to 70°-72°F. (21.1°-22.2°C.) and add 0.25-1.0 percent of bacterial culture.

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Thoroughly mix the reconstituted skim milk and culture, and incubate at 70°-72°F. (21.1°-22.2°C.) for 14 to 16 hours or until an acidity of 0.8-0.85 percent is reached. Then cool the culture or starter in ice water and keep it at 40°F. (4.4°C.) until used. The culture or starter should be smelled and tasted daily to determine whether it maintains desirable flavor and aroma.

The bulk starter is usually made in well-tinned or stainless steel 10-gallon cans or in special starter vats. Heat and hold reconstituted skim milk at 190°F. (87.8°C.) for 30 minutes or more. Then cool it to 70°-72°F. (21.1°-22.2°C.) and inoculate it with 0.5 percent or more of mother culture or starter--enough to produce an acidity of 0.8 percent or more in 14 hours. If the bulk starter is not used immediately after preparation, cool it to 40°F. (4.4°C.) without agitation and store it at this temperature, but not for more than 2 days.

MANUFACTURING PROCEDURE

Buttermilk may be made from reconstituted nonfat dry milk or from recombined milk. The reconstituted nonfat milk to be made into buttermilk may contain from 9 percent to 11 percent nonfat milk solids. After the reconstituted skim milk has been prepared in accordance with instructions in Recombined Milk, pasteurize it at 180°-195°F. (82.2°-90.6°C.) for 20-40 minutes.

After pasteurization cool the milk to 70°-72°F. (21.1°-22.2°C.) and inoculate it with 0.5-1 percent of previously prepared bulk starter. Agitate the milk thoroughly when adding the bulk starter and then allow it to remain undisturbed at 70°-72°F. (21.1°-22.2°C.) until it shows the desired degree of coagulation and acidity. The quantity of starter used depends upon how active it is and when the finished product is to be completed. The finished product has an acidity of 0.80-0.85 percent, which should develop in 12 to 16 hours after the bulk starter has been added to the milk. When the milk has reached the desired degree of coagulation and acidity, break it to a smooth consistency by using a high-speed agitator and then cool it as quickly as possible to 40°F. (4.4°C.) or lower, using a slow-speed agitator.

If salt and butter granules are desired in the finished buttermilk, add them during agitation. Salt at the rate of 8-10 ounces (226.8-283.5 gm.) per 100 gallons (378 liters) of buttermilk will usually improve the flavor. Do not add the butter granules until the temperature of the buttermilk is 50°F. (10°C.) or lower. If excessive amounts of air are incorporated in the buttermilk during cooling, allow it to remain undisturbed for at least 3 or 4 hours before bottling. Just before bottling stir it gently.

Buttermilk with a heavy body can be obtained by increasing the nonfat milk solids to 11 percent, by increasing the pasteurization temperature to 195°F. (90.6°C.) and by holding at the 195°F. (90.6°C.)

temperature for up to 1 hour. Higher developed acidities will also give a heavier body.

To obtain a lighter body with less viscosity, use less solids (not over 9 percent), a lower pasteurization temperature (180°-185°F., or 82.2°-85°C.) or a shorter period (30 min.), develop not more than 0.8 percent acidity, or reduce the acidity to 0.8 percent by adding cold skim milk to the buttermilk after it has been cooled.

To reduce wheying off (liquid separation), use a high solids content; use a high pasteurization temperature for a longer holding period; develop an acidity that does not require adjustment with skim milk; cool the buttermilk to at least 40°F. (4.4°C.) and keep it cold; and prevent excessive incorporation of air in the buttermilk at the time of bottling.

CREAMED BUTTERMILK

To make creamed buttermilk, add to nonfat buttermilk, just before bottling it, enough homogenized cream to bring the butterfat content to approximately 2.0 percent.

The addition of cream improves the flavor and tends to give a smoother, less sharp acid flavor to the buttermilk.

Butterfat may be added as butter granules rather than as cream. In this procedure, highly colored cream (butter color added) is churned until small butter granules (smaller than wheat kernels) are obtained. The granules are then added to the buttermilk at the rate of about 1.0 percent butterfat.

Butter granules of the proper size and color, well distributed through buttermilk of the proper viscosity, can add greatly to the appearance of the finished product.

COTTAGE CHEESE

STARTER PREPARATION

The bulk starter is prepared in the same way as for cultured (lactic) buttermilk. A fresh, smooth, active starter of good flavor with about 0.85 percent acidity is an important factor in making good cottage cheese.

MANUFACTURING PROCEDURES

Low-heat spray-process nonfat dry milk is used for making cottage cheese. Two procedures or methods may be used - the short-set method and the long-set method. Either method makes excellent cottage cheese, but the short-set method can be more closely controlled.

Regardless of the method used, nonfat dry milk offers distinct advantages over fluid skim milk in making the cheese. It can be kept readily available, and its use provides a uniformly good product, an increased yield, a saving in vat space, and less variations in daily processing and in the quality of the finished product.

A reconstituted skim milk containing 11 percent nonfat milk solids is best.

SHORT-SET METHOD

The short-set method usually requires 6 to 8 hours, depending on the activity of the starter and the amount used.

In making cottage cheese by this method as high as 14 percent of the nonfat milk solids may be used. However, 11 percent appears to give best results.

Mix 11 pounds (5 kg.) of the nonfat dry milk with 89 pounds (40.5 kg.) of a good-quality, potable water at a temperature of 72°-75°F. (22.2°-24.0°C.) to make 100 pounds (45.5 kg.) of skim milk. A powder-mixing unit (as shown in Recombined Milk) is advantageous where large quantities of nonfat dry milk are to be used. Dissolve the nonfat dry milk thoroughly and determine the titratable acidity. Then heat the reconstituted skim milk in the cheese vat to the setting temperature of 90°F. (32.2°C.), and add calcium chloride (if rennet coagulator is used) at the rate of 3 to 5 milliliters of a saturated calcium chloride solution, diluted with 30 parts of water per 100 pounds (45.5 kg.) of skim milk. Stir thoroughly.

Now add fresh, smooth starter at the rate of 5 to 8 percent. Stir the milk thoroughly and determine its acidity. Restir every 30 minutes, keeping the temperature at 90°F. (32.2°C.). At the end of 90 minutes, again determine the acidity. If the starter is working properly, the acidity at this time is at least 0.06 to 0.08 percent higher than at the start. If it is not, add more starter--1 percent more for each 0.01 percent that the acidity is below the 0.06 percent increase.

Next, add the coagulator. Add rennet at the rate of 0.1 to 0.15 milliliters per 100 pounds (45.5 kg.) of milk. Dilute the rennet with 30 parts of cold water and stir in thoroughly. (Other types of coagulators should be added according to instructions that come with them.) Cover the vat and allow the mixture to stand undisturbed for about 2-1/2 hours. If the curd is firm by that time, draw off a sample with a milk pipette, moving the pipette up and down through the curd in order to obtain a uniform sample. Place the curd in a clean cream test bottle and centrifuge in a Babcock tester to obtain the clear whey. Draw off 9 grams (8.8 ml.) of the clear whey and titrate for acidity. The curd is ready to cut when the whey acidity is 0.34-0.36 percent higher than the initial titratable acidity of the skim milk prior to the addition of the starter. A new sample of curd should be used to obtain the whey for each test.

When the acidity of the whey reaches the level indicated above, the curd should be firm enough to cut. At this point it is advisable to test the firmness with a floating thermometer. If the thermometer is inserted in the curd at an angle and raised through the curd, the curd should break in a straight line. When this occurs, the curd is ready to cut. Cut first with the horizontal knife lengthwise of the vat, then cut lengthwise with the vertical knife, and then crosswise with the vertical knife (use a 1/4-inch to 1/2-inch knife, depending on size of curd desired).

After the curd is cut, allow it to set for 15 minutes; gently add water at 120°F. (48.9°C.) to form a layer about 3 inches deep over the curd; and gently stir, pushing in toward the center from the sides and ends. The addition of this water will enable the curd to be stirred without excessive breakage. However, stir the curd only often enough to prevent matting.

Maintain the temperature of the water in the jacket of the cheese vat about 20°-30°F. (11.1°-16.7°C.) higher than the temperature of the curd until the curd has reached the degree of firmness desired. This firmness is usually obtained at a temperature of 115°-120°F. (46.1°-48.9°C.) in about 2 hours time, but it may occasionally take a higher temperature and a longer cooking time.

Firmness of the curd, to determine if it has been cooked sufficiently, can be best checked by chilling some of the curd particles in cold water. When the curd has been cooked sufficiently, drain the water in the jacket and drain the whey until the curd begins to show. Then add water at about 90°F. (32.2°C.) until the curd temperature reaches 90°F. (32.2°C.).

At this point, drain the curd completely and wash it with two washings of cold water. Temperature of water in the final washing is about 35°F.(1.7°C.) and the final curd temperature should be 40°F. (4.4°C.) or lower. Drain the curd thoroughly. Add salt, usually at the rate of about 2 percent, and cream (18 percent) at the rate of 1 pound (0.45 kg.) of cream to 3 pounds (1.36 kg.) of curd.

If the cottage cheese is to be stored for more than two days, store it in the dry form and cream it the day before it is to be sold. Cottage cheese should always be kept at temperatures below 40°F. (4.4°C.). Under the best conditions it has a shelf life of approximately 10 days.

LONG-SET METHOD

The long-set method may be better suited to some plant operations. Following are the modifications necessary from the short-set method:

1. Pasteurize the reconstituted nonfat dry milk (skim milk) at 143°F. (61.7°C.) for 30 minutes or at 161°F. (71.7°C.) for 15 seconds.

2. Set the skim milk at a temperature of 70° to 75°F. (21.1° to 24°C.).

3. Setting time, 12 to 16 hours.

4. Add starter at the rate of 0.25-1.0 percent, depending on activity of starter and desired setting period. For a 14-hour setting period, 0.5 percent starter should be the amount to use.

5. Longer cooking time than for the short-set method. Temperature of the curd should be raised more slowly at the start--up to 100°F. (37.8°C.)--than for the short-set method, to prevent the forming of a tough film on the curd particle.

YOGHURT

Yoghurt is a form of buttermilk or fermented milk particularly popular in southeastern Europe, southern Asia, and northern Africa. It differs from U. S. cultured buttermilk in that it has a much heavier body and is consumed as a custard rather than as a liquid.

Yoghurt cultures consist of a mixture of at least three kinds of bacteria of known types, namely Streptococcus thermophilus, Lactobacillus bulgaricus, and Plocamobacterium yoghurti.

These organisms are ordinarily obtained in a mixed culture. Several firms in the United States distribute such a culture.

STARTER PREPARATION

Fill a clean quart or liter bottle about two-thirds full of reconstituted skim milk (11 percent solids) and cover loosely. Sterilize the skim milk in an autoclave at 15 pounds pressure for 20 minutes, or without pressure for one hour. If neither type of sterilizer is available, the skim milk may be satisfactorily treated by placing the bottle in a water bath filled with water to about one inch below the top of the bottle. The bath is then covered loosely and the water is boiled slowly for one hour.

Cool the skim milk--slowly, so as not to break the bottle--to about 110°F. (43.3°C.). Add a bottle of commercial yoghurt culture and mix thoroughly with a swirling motion. After mixing, place the bottle or bottles containing the mixture in an incubator and hold at 100°F. (37.8°C.) until the milk is coagulated (agitate the milk several times during the first hour). It may take up to 24 hours for the first inoculation to set or coagulate; after that the setting time will be about 8 hours. At higher temperatures (110°-115°F., or 43.3°-46.1°C.) the skim milk will usually set in about 4 to 5 hours, but the higher temperatures greatly shorten the life of the culture, for some of the bacteria grow faster than the others and eventually only one kind will be present in the culture.

After the mother culture or starter is coagulated, remove it from the incubator, chill it in ice water, and place it in a refrigerator until time to make up the bulk starter.

To prepare the bulk starter, place skim milk in a well-tinned metal or stainless steel can with a lid and heat it to boiling with frequent stirring. Hold the milk at boiling for 30 minutes, cool it to 100°F. (37.8°C.), and inoculate it with a 2 percent inoculation of the mother starter. (The quart or liter bottle of mother starter is sufficient to inoculate 40 quarts (37.84 liters) of bulk starter.) Mix thoroughly. Hold the can or cans at 100°F. (37.8°C.) until the skim milk is coagulated (usually 8 hours). Cool to 60°F. (15.6°C.) and store in a refrigerator until used.

MANUFACTURING PROCEDURE

To prepare 100 pounds (45.45 kg.) of recombined milk containing 3 percent milk fat and 13 percent nonfat milk solids for yoghurt manufacture, use 13 pounds (5.9 kg.) of nonfat dry milk, 3 pounds (1.36 kg.) of anhydrous milk fat, and 84 pounds (38.18 kg.) of water.

Pasteurize the milk at 143°F. (61.7°C.) for 30 minutes, or at 161°F. (71.7°C.) for not less than 15 seconds; homogenize and cool to 110°F. (43.3°C.); and add 2 percent of the yoghurt bulk starter and mix thoroughly.

Place the inoculated milk into the clean, final containers (glass or plastic); cover and incubate at 110°F. (43.3°C.) until the milk is coagulated (usually 4 to 5 hours); then place in a refrigerator to cool (usually overnight). The yoghurt should have a smooth, heavy body and a clean, acid flavor. It should retain its good qualities for at least a week if kept refrigerated.

TABLE CREAM

In making table or light cream from nonfat dry milk and anhydrous milk fat, proceed as for recombined milk. For every 100 pounds (45.45 kg.) of finished product desired, use 7.5 pounds (3.41 kg.) of nonfat dry milk, 18 pounds (8.18 kg.) of anhydrous milk fat, and 74.5 pounds (33.8 kg.) of water. After mixing, pasteurize at 143°F. (61.7°C.) for not less than 30 minutes; homogenize at not over 500 pounds (227.3 kg.) pressure per square inch; and cool to 40°F. (4.4°C.).

HALF AND HALF

Half and half is a homogenized product, half milk and half cream, testing 10-12 percent milk fat. It is excellent for cereals, fruits, and coffee, and is gaining popularity in the United States.

MANUFACTURING PROCEDURE

To make half and half, follow instructions for making recombined milk. For every 100 pounds (45.45 kg.) of finished product desired, use

10 pounds (4.55 kg.) of anhydrous milk fat, 9 pounds (4.1 kg.) of nonfat dry milk, and 81 pounds (36.82 kg.) of water. After mixing, pasteurize at 143°F. (61.7°C.) for not less than 30 minutes; homogenize at 1,000-1,500 pounds (454.5 to 681.8 kg.) pressure; and cool to 40°F. (4.4°C.).

WHITE CHEESE

Many types of cheese can be made from recombined milk.

Experimental work has been done on white cheese,[2] a type made and used in many countries. It is used extensively in Latin America, where it is known as queso blanco.

MANUFACTURING PROCEDURE

Prepare 100 pounds (45.45 kg.) of milk as follows: Use 11 pounds (5 kg.) of low-heat spray-process nonfat dry milk to 86 pounds (39.1 kg.) of good-quality potable water at a temperature of 70°-80°F. (21.1°-26.7°C.). Mix the resulting skim milk thoroughly and heat to 140°F. (60°C.) for 10 minutes. Draw off three-fourths of the skim milk and add 3 pounds (1.36 kg.) of anhydrous milk fat to the remaining fourth of the skim milk. Mix thoroughly and homogenize the resulting 28 pounds (12.72 kg.) of milk at 500 pounds (227.3 kg.) pressure. Mix the two lots of milk (skim and whole) in a cheese vat, and cool to 94°F. (34.4°C.).

Add 0.5 pounds (0.225 kg.) of a good-quality lactic starter (as prepared for buttermilk) per 100 pounds of milk, stir thoroughly, and allow to set for 30 minutes.

Dilute 5 milliliters of a saturated solution of calcium chloride in 40 milliliters of water, add to 100 pounds (45.45 kg.) of milk, and stir thoroughly.

Add rennet extract at the rate of 0.3 ounces (8.5 gm.) diluted with at least 100 milliliters of cold water to 100 pounds (45.5 kg.) of milk; or use rennet tablets--1½ tablets (1-75 liter strength) dissolved in 100 milliliters of cold water to 100 pounds (45.5 kg.) of milk. (Follow the instructions given for diluting the particular type of the coagulator used.) Stir thoroughly. This should give a firm coagulation, ready to cut in 45 to 60 minutes.

When a firm curd has formed, cut vertically lengthwise and crosswise of vat with a 1/4-inch or 1/2-inch cheese knife.

Allow the curd to set undisturbed for 15 minutes, then stir gently with a curd rake, and dip the curd into hoops or perforated cheese forms lined with cheese cloth.

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[2] The method given here is a modification of the method developed at Ohio State University, Columbus, Ohio, by Dr. W. H. Harper, Department of Dairy Technology, and L. H. Burgwald, Foreign Agricultural Service, U. S. Department of Agriculture.

Turn the cheese after 30 minutes. At the end of another 30 minutes, remove the curd from the hoops or forms and weigh. Break up the curd in the vat, and salt with regular salt (sodium chloride) at rate of 8 to 9 percent of curd weight.

Rehoop and press the cheese using 10-pound weight (4.55 kg.). Turn the cheese each hour for the first 2 hours after salting. Then press the cheese overnight using 10-pound to 25-pound weights (4.55 to 11.36 kg.).

Yield will be about 13 pounds (5.9 kg.) of pressed cheese per 100 pounds (45.5 kg.) of milk.

PRECAUTIONS

In making white cheese (queso blanco) from recombined milk, soluble calcium salts must be added at the rate indicated, to replace the calcium normally present in milk but made insoluble during the milk-drying process. Otherwise the curd will be too soft, cannot be cut properly, and will not drain readily.

The milk fat must be added to only 20 to 25 percent of the milk and the mixture homogenized at a low pressure-- 500 pounds (227.3 kg.). If fat is homogenized into all of the milk, the curd will be too soft to cut properly and will not drain readily.

PROCESSED WHITE CHEESE

White cheese or queso blanco can be processed in the same way as any other type of cheese.

One method successfully used in Central America employed the following procedure: To 4.5 pounds (2.05 kg.) of ground cheese add 4 ounces (113.5 gm.) of butter, 7 ounces (178.8 gm.) of water, and 2 ounces (56.8 gm.) of stabilizer (disodium phosphate) in a steam-jacketed processing kettle; heat to 158°F. (70°C.) in 4 minutes; shut off steam and hold at that temperature for 1 minute; then pour into pliofilm-lined boxes.

PROCESSED WHITE CHEESE BLENDED WITH AGED AMERICAN CHEDDAR CHEESE

A highly acceptable product results when processed white cheese or queso blanco is combined with aged American Cheddar cheese.

Blend 25 to 50 percent by weight of the aged American Cheddar cheese with the white cheese or queso blanco, and process as outlined for processed queso blanco. Reduce the amount of butter in proportion to the amount of Cheddar cheese blended with the queso blanco.

ICE CREAM

Ice cream can be made from nonfat dry milk and anhydrous milk fat.

Formulas for ice cream vary considerably. Fat content may be from 8 to 16 percent; nonfat milk solids from 9.5 to 11 percent; sugar from 13 to 17 percent, and stabilizer 0.25 to 0.5 percent. The addition of a little salt, not over 0.1 percent, will help the flavor. Formulas for ice cream are found in Recombined Milk.

FLAVORED MILK DRINKS

In many countries flavored milk drinks such as chocolate, coffee, vanilla, and strawberry, are popular. Of these, chocolate is probably the most uniformly liked. Formulas for chocolate-flavored milk drinks are found in Recombined Milk.

WHIPPED MILK-FAT SPREAD

A milk-fat spread, similar to butter, can be made from anhydrous milk fat. A formula for a small quantity of this product is as follows: 363 grams of anhydrous milk fat, 70 grams of water, 9 grams of salt, and 12 grams of lactic starter culture.

MANUFACTURING PROCEDURE

Melt the fat by warming to 115°F. (46.2°C.). Dissolve the salt in the water and then add it to the fat. Next add lactic starter culture and whip the mixture until it is smooth and creamy. Place the product in the final container and chill. Use like butter.

For large-scale production, use a batch-type ice cream freezer without refrigeration for whipping the ingredients.

On a 100-pound basis, use 80 pounds (36.36 kg.) of anhydrous milk fat, 15.4 pounds (7 kg.) of water, 2 pounds (0.91 kg.) of salt, and 2.6 pounds (1.18 kg.) of lactic starter culture.

STERILIZED MILK

In many hot countries where both milk and refrigeration are scarce, the use of sterilized recombined milk can play an important part in the nutrition of the inhabitants.

Recombined milk is made as described in Recombined Milk. It is then pre-sterilized in a continuous flow pre-sterilizer, bottled, and subjected to either batch or continuous in-bottle sterilization.

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